

**Report Date:** 30 Jun 2014

**Summary Report for Individual Task  
551-88L-3071  
Troubleshoot a Potable Water System  
Status: Approved**

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**Distribution Restriction:** Approved for public release; distribution is unlimited.

**Destruction Notice:** None

**Foreign Disclosure: FD5** - This product/publication has been reviewed by the product developers in coordination with the [installation/activity name] foreign disclosure authority. This product is releasable to students from all requesting foreign countries without restrictions.

**Condition:** Given a potable water system, aboard a vessel, at sea, at anchor or moored alongside a pier, day or night, under all sea and weather conditions, wearing appropriate PPE, (i.e. hearing protection, eye protection, etc.), lock out tag out kit and a marine rail tool box.

**Standard:** The Soldier correctly conducts troubleshooting procedures of a potable water system aboard an Army vessel, IAW the appropriate Technical Manual and local SOPs, without injury to self or others and without damage to equipment.

**Special Condition:** None

**Safety Risk:** High

**MOPP 4:**

<b>Task Statements</b>
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**Cue:** None

**DANGER**

None

**WARNING**

None

**CAUTION**

None

**Remarks:** None

**Notes:** None

### Performance Steps

1. Demonstrate basic knowledge for troubleshooting procedures of the potable water system.

a. Before being able to identify problems with the system, it will be helpful to be familiar with the characteristics of a normal, properly running, potable water system.

b. During normal operation:

(1) The unit WILL be quiet, and free from excessive vibration, clicking or "metallic" noises.

(2) All high and low pressure fittings WILL be dry, and free from leaks.

(3) Pump exterior surfaces WILL be free from excessive mineral and salt deposits.

(4) The case should be free of oil leakage, or excessive black debris caused by severe drive belt wear.

2. Perform troubleshooting procedures for potable water system.



Reverse Osmosis System  
Figure 551-88L-3071\_01

a. Unit will not start.

(1) Possible causes.

(a) No power

(b) Incorrect voltage, hertz, or phase

(c) Low feedwater pressure

(d) Low pressure switch malfunction

- (e) Loose or wrong connections in control box
- (f) Loose or wrong connections in junction box
- (g) Thermal overload on motor starter tripped
- (h) Thermal overload on motor starter malfunction
- (i) High pressure switch malfunction
- (j) Circuit breaker tripped

(2) Corrective action.

(a) Check with Volt-Ohm Meter to be sure power is present at the unit. If no power at unit, check line breakers, fuses, etc.

(b) Check that line Voltage/Hertz/Phase is identical with Voltage/Hertz/Phase shown on unit Model/Serial Number Nameplate, and on motor rating plate.

(c) Confirm that boost pump is operating properly and that all valves to unit are open. Confirm boost pump capacity is at least equal to rated capacity required for unit. Check all filters for clogging. Check inlet lines for blockage or for diversions. Check all inlet piping for correct piping runs.

(d) With water pressure on unit and unit off, disconnect low pressure lead #6 (blue-C) and #7 (red-NO) from terminal block in junction box on unit frame upright. Use VOM to check if there is continuity between low pressure switch leads #6 and #7 with water pressure at 5 psig (0.4kg/cm<sup>2</sup>) or higher. If there is no continuity, switch is bad and must be replaced.

(e) Check all control box connections for tightness. Verify all wire numbers match terminal block numbers exactly.

(f) Check all junction box connections for tightness. Verify all wire numbers match terminal block numbers exactly.

(g) The thermal overload reset function is factory set on automatic and should reset itself within five minutes. If it does not, check to see that reset function switch on the motor starter is set on automatic. If it is on test or manual, reset by depressing reset button. Then turn function switch to automatic. An audible "click" will be heard when the motor starter resets.

(h) If unit does not start after motor starter has reset and there is reason to suspect a bad thermal overload, connect wires #7 and #8 together at motor starter and try to start unit. If unit starts overload is bad and must be replaced. NOTE: Be sure that overload has had time to cool off. If the overload temperature remains above its set point, it will not reset. This does not indicate a faulty overload. Overload is faulty if its temperature is below its set point and the overload remains open-circuited. Also verify that the adjustable amperage setting on the motor starter is set at least at the full load amperage draw found on the motor rating plate. If not, use a small screwdriver to adjust it to the correct setting.

(i) With no power to the unit, disconnect high pressure switch lead #5 (red-NC) and #6 (blue-C) at terminal block in junction box on unit. Use VOM to check continuity across switch. If VOM indicates no continuity, switch is bad and must be replaced.

(j) Check circuit breaker on control box and reset by depressing button in center of circuit breaker.

b. Unit starts, trips out.

(1) Possible causes.

- (a) Low feedwater pressure
- (b) Improper voltage/hertz/phase to motor
- (c) Motor wired incorrectly
- (d) High membrane pressure
- (e) Lost charge in pulsation dampener

(2) Corrective action.

(a) Verify that low pressure switch is operating properly. Confirm that boost pump is operating properly and that there are no restrictions in feed line. Check inlet line to be sure there are no diversions between boost pump and high pressure inlet. Check filters for clogging. Check inlet lines for blockage. Be sure supply piping is adequate in volume for size of pump.

(b) Check that Voltage/Hertz/Phase to motor are identical to Voltage/Hertz/Phase on motor rating plate and on unit Model/Serial Number Nameplate.

(c) Check motor rating plate and motor wiring diagram (on rating plate or inside lid of motor junction box) to be sure motor is correctly connected to incoming power cable.

(d) Verify that high pressure switch is operating properly. Verify that pulsation dampener is charged to 450 psig (check pressure only while unit is not running). Verify regulator valve is open completely.

(e) If pulsation dampener charge is inadequate, the hydraulic pulsation may cause a Dampener premature high pressure failure. Charge the pulsation dampener to 450 psig (31 kg/cm<sup>2</sup>) with nitrogen while the unit is not running.

c. Unit will not achieve full pressure.

(1) Possible causes.

- (a) Gross leak/Loose belts
- (b) Lost charge on pulsation dampener/low pump speed

(2) Corrective action.

(a) Inspect and repair defective piping and connections. Loose Belts Adjust motor position on base plate to prevent slippage of belts on sheaves. **DO NOT MOVE PUMP TO TIGHTEN BELTS AS THIS WILL DISTURB SEALS OF HIGH PRESSURE LINE CONNECTIONS.** NOTE: A belt tightening tool (available from Allied Water Corporation) is necessary to get adequate tension on the drive belt. Belts must be aligned within 1/16" (2mm) to prevent excessive wear and overheating.

(b) Check belt tension as above and adjust as necessary. **DO NOT MOVE PUMP TO ADJUST BELT TENSION.** Check motor and pump sheaves for correct size and replace if necessary.

d. Salinity light will not go out.

(1) Possible causes.

- (a) Loose connections

(b) Relay burned out, sensor probe malfunction

(c) Low feedwater flow

(d) High salinity feedwater

(e) Divert valve leaks back

(f) Product flow too high

(g) Membranes fouled

(2) Corrective action.

(a) Check all connections marked R,W,Bk,Gr (color coded wires) from sensor to Printed Circuit Board (PCB) for tightness. Check to be sure that no terminal block is clamped on insulation rather than on bare wire. Check any splices in these wires for tightness.

(b) Check divert relay and replace if necessary. Disconnect quick-disconnect fitting and unscrew probe from tee. Plug tee. Reconnect quick-disconnect. With power on unit and probe in air, salinity light should go off. Placed in 1000 Mg/L water but NOT TOUCHING THE CONTAINER, light should go on. If light stays on with power on and probe in air, and other tests above check out O.K., probe is bad or sensor wire is bad and should be replaced. NOTE: Do not attempt to remove probe with quick disconnect connected as sensor wires are brittle and will twist off inside bundle. Always handle probe and wire bundle with great care to avoid damage to sensor wires. If a second probe is available, the probe function can be checked by connecting spare probe and checking probe function as above. If light goes out with connected (spare) probe in air, unit probe is bad and should be replaced.

(c) Check that feedwater flow is adequate as outlined above "Unit Starts, Trips Out" Low flow to the unit can cause low flow over the membranes, resulting in high salinity product water.

(d) The unit rating is based on 36,000 Mg/L seawater. Higher concentrations of salt in the feedwater may raise the product salinity level above the factory pre-set limit at which the salinity light will illuminate. Consult Allied if higher salinity feedwater than 36,000 Mg/L is encountered.

(e) Disconnect quick-disconnect of sensor. Remove sensor from tee. Plug tee. Reconnect quick-disconnect of sensor. Disconnect piping from inlet of divert valve. Disconnect piping from Product-To-Storage outlet of divert valve. Start unit. There should be at most a trickle of water back out of the divert valve inlet. If there is any strong flow, divert valve is leaking back and must be cleaned of gravel, etc., or must be replaced.

(f) If product flow is higher than rated flow of unit, brine salinity will be high and therefore product salinity will be high. Open regulator until rated flow is attained.

(g) If membrane is fouled (scaled), product water TDS will increase and/or product water flow will decrease. Either case can cause a high salinity indication. Clean membranes following cleaning procedure found elsewhere in this manual. If after cleaning, membranes still do not perform satisfactorily, contact Allied Water Corporation for direction.

e. Excessive vibration.

(1) Possible causes.

(a) Loss of charge in accumulator

(b) Unit not mounted on a solid base

(c) Low feedwater flow

(d) Air in feedwater

(2) Corrective action.

(a) Check the accumulator as described above in "Unit Starts, Trips Out".

(b) Be sure unit is bolted to a firm, non-vibrating surface.

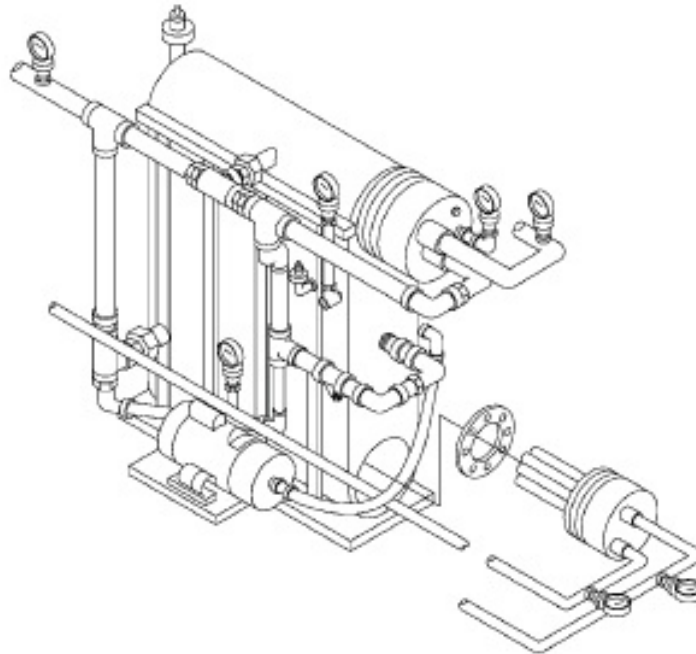
(c) Low feedwater flow can cause pump cavitation which will cause very heavy vibration and possible knocking in the H.P. pump.

## WARNING

THIS CONDITION WILL CAUSE PUMP FAILURE; DO NOT OPERATE THE UNIT WITH THE PUMP CAVITATING.

(d) Air in feedwater flow can cause cavitation, vibration, and knocking. Check all feedwater lines for possible air sources. Check boost pump for adequate feed.

3. Perform troubleshooting procedures for waste heat evaporator (WHE).



Waste Heat Evaporator (WHE)

Figure 551-88L-3071\_02

a. Insufficient auxiliary seawater pump pressure (reading below 45 psig on seawater pressure gauge).

(1) Possible causes.

(a) Clogged seawater strainer.

(b) Sea chest fouled.

(c) Malfunction of auxiliary seawater pump.

(2) Corrective action.

(a) Remove strainer basket and clean

(b) Perform sea chest blow down procedures.

(c) Inspect pump for leakage or breakage. Also inspect electrical connections

b. Red alarm indicator and blue strobe on salinity panel illuminated.

(1) Possible causes.

(a) Overboard discharge valve throttled or shut.

(b) Relay armature differential.

(c) Salinity cell electrodes are dirty, have blemished surfaces or are fouled.

(d) Insufficient auxiliary seawater pump pressure.

(e) Malfunctioning salinity panel.

(f) Clogged brine jet pump (high seawater level in shell).

(g) Scaled Waste Heat Evaporator.

(h) Freshwater condenser leak.

(2) Corrective action.

(a) Fully open distillate discharge valve.

(b) Turn salinity panel power off momentarily and then back on.

(c) Service Salinity cell.

(d) Remove seawater strainer basket and clean; Inspect pump for leakage or breakage.

(e) Check electrical system for loose wires, relay, fuse or PCB. Tighten loose components or replace.

(f) Inspect seawater strainer basket for large holes. Remove brine jet pump assembly. Remove, inspect and clean nozzle, replace if necessary.

(g) Service Waste Heat Evaporator.

(h) Remove freshwater condenser bundle and inspect. Perform hydrostatic test if necessary. Replace if damaged.

Note: A reduction in capacity will be experienced when operating in warmer seawater.

c. Evaporator produces product water, but at a reduced capacity.

(1) Possible causes.

- (a) Insufficient shell vacuum.
- (b) Malfunctioning distillate pump.
- (c) Clogged feed orifice.
- (d) Excessive scale on seawater heater bundle.

(2) Corrective action.

(a) Inspect sight glass and gasket, ensure intact. Inspect all joints for tightness. Ensure vacuum release valve is closed. Inspect seawater pressure gauge, to maintain pressure. (Should be a minimum of 45 psig.) Remove vacuum jet pump. Remove, inspect and clean nozzle. Inspect seawater strainer basket for holes. Perform Hydrostatic test of seawater heater and freshwater condenser bundles.

- (b) Ensure freshwater valves are fully open. Inspect distillate pump for leak. Repair as necessary.
- (c) Remove feed orifice, clean and clear any obstructions.
- (d) Service waste heat Evaporator.

d. Evaporator is not producing water.

(1) Possible causes.

- (a) Malfunctioning distillate pump.
- (b) Air leakage in suction line of distillate pump.

(2) Corrective action.

- (a) Inspect distillate pump for leaks or damage. Inspect electrical connections, tighten as necessary.
- (b) Inspect and reseal leaking connections. Throttle discharge distillate valve if necessary.

e. Failure to pump or feed.

(1) Possible causes.

- (a) Leak in suction side of pump.
- (b) Valve seats not sealing.
- (c) Low solution level.
- (d) Diaphragm ruptured.

(e) Pump head cracked or broken.

(f) Pump head contains air.

(2) Corrective action.

(a) Inspect tubing for cracks or damage, repair or replace. Check for loose fittings, tighten as necessary.

(b) Clean valve seats, or replace.

(c) Solution must be above foot valve.

(d) Replace diaphragm.

head. (e) Replace pump head. Ensure fittings are hand tight only. Using pliers or wrench on fittings can crack pump

(f) Close all pressure valves, and loosen outlet tubing connection at discharge point. Remove head assembly, inspect ball and seat valves. Apply a few drops of solution to the ball check and seat valves. Set feeder dial to maximum rate and turn on feeder. When pump is primed, reconnect all tubing connections.

f. Unit loses prime.

(1) Possible causes.

(a) Dirty back check valve.

(b) Ball checks not seating or not sealing properly.

(c) Solution container has run dry.

(2) Corrective action.

(a) Service or replace back check valve.

(b) Inspect and service back check, head or foot valve assemblies or replace.

(c) Refill container with proper chemical.

g. Fitting leakage.

(1) Possible causes.

(a) Loose fittings.

(b) Broken or worn gasket.

(2) Corrective action.

(a) Ensure all fittings are hand tight.

(b) Inspect gaskets, and replace if broken or worn.

h. Chemical injection pump will not prime.

(1) Possible causes.

(a) Too much pressure at discharge.

(b) Valves are not sealing.

(c) Feeder dial not set at maximum.

(2) Corrective action.

(a) Close all pressure valves, and loosen outlet tubing connection at discharge point. Remove head assembly, inspect ball and seat valves. Apply a few drops of solution to the ball check and seat valves. Set feeder dial to maximum rate and turn on feeder. When pump is primed, reconnect all tubing connections.

(b) Remove all valves, inspect for damaged or worn components, service and replace damaged components.

(c) Always prime pump with output dial set at maximum rated capacity.

i. Chemical injection pump motor fails to operate.

(1) No power to chemical injection pump.

(2) Remove and replace motor.

j. Chemical agitator not operating.

(1) Check local power switch and circuit breakers.

(2) Remove and replace motor.

(Asterisks indicates a leader performance step.)

**Evaluation Guidance:** None

**Evaluation Preparation:** None

PERFORMANCE MEASURES	GO	NO-GO	N/A
1. Demonstrated basic knowledge for troubleshooting procedures of the potable water system.			
2. Performed troubleshooting procedures for potable water system.			
a. Unit will not start.			
b. Unit starts, trips out.			
c. Unit will not achieve full pressure.			
d. Salinity light will not go out.			
e. Excessive vibration.			
3. Performed troubleshooting procedures for waste heat evaporator (WHE).			
a. Insufficient auxiliary seawater pump pressure.			
b. Red alarm indicator and blue strobe on salinity panel illuminated.			
c. Evaporator produces product water, but at a reduced capacity.			
d. Evaporator is not producing water.			
e. Failure to pump or feed.			
f. Unit loses prime.			
g. Fitting leakage.			
h. Chemical injection pump will not prime.			
i. Chemical injection pump motor fails to operate.			
j. Chemical agitator not operating.			

**Supporting Reference(s):**

Step Number	Reference ID	Reference Name	Required	Primary
	TM 55-1915-207-24&P	UNIT, INTERMEDIATE DIRECT SUPPORT AND INTERMEDIATE GENERAL SUPPORT MAINTENANCE MANUAL (INCLUDING REPAIR PARTS AND SPECIAL TOOLS LIST) WATER PURIFICATION SYSTEM, SW-1000 SERIES IV, P/N AW 595-37352-4 (REPR	No	No

**Environment:** Environmental protection is not just the law but the right thing to do. It is a continual process and starts with deliberate planning. Always be alert to ways to protect our environment during training and missions. In doing so, you will contribute to the sustainment of our training resources while protecting people and the environment from harmful effects. Refer to FM 3-34.5 Environmental Considerations and GTA 05-08-002 ENVIRONMENTAL-RELATED RISK ASSESSMENT.

**Safety:** In a training environment, leaders must perform a risk assessment in accordance with ATP 5-19, Risk Management. Leaders will complete the current Deliberate Risk Assessment Worksheet in accordance with the TRADOC Safety Officer during the planning and completion of each task and sub-task by assessing mission, enemy, terrain and weather, troops and support available-time available and civil considerations, (METT-TC). Note: During MOPP training, leaders must ensure personnel are monitored for potential heat injury. Local policies and procedures must be followed during times of increased heat category in order to avoid heat related injury. Consider the MOPP work/rest cycles and water replacement guidelines IAW FM 3-11.4, Multiservice Tactics, Techniques, and Procedures for Nuclear, Biological, and Chemical (NBC) Protection, FM 3-11.5, Multiservice Tactics, Techniques, and Procedures for Chemical, Biological, Radiological, and Nuclear Decontamination.

**Prerequisite Individual Tasks :** None

**Supporting Individual Tasks :** None

**Supported Individual Tasks :** None

**Supported Collective Tasks :** None

**ICTL Data :**

ICTL Title	Personnel Type	MOS Data
88L30 Watercraft Engineer	Enlisted	MOS: 88L, Skill Level: SL3, Duty Pos: TFR, LIC: EN
88L40 Watercraft Engineer	Enlisted	MOS: 88L, Skill Level: SL4, Duty Pos: TGB, LIC: EN, SQI: O